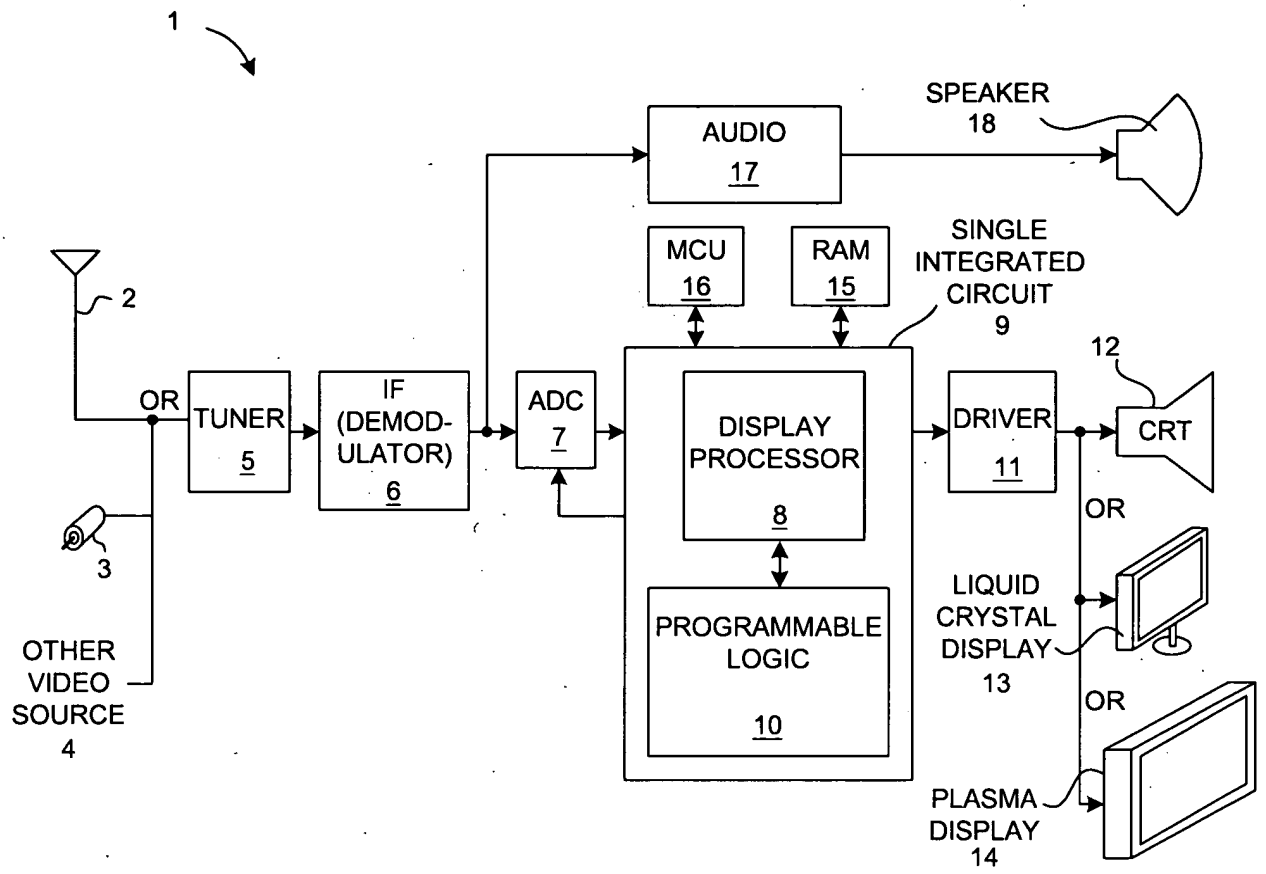

1
SPEAKER
18
AUDIO
17
MCU
16
RAM
15
SINGLE
INTEGRATED
CIRCUIT
9
2
OR
TUNER
5
IF
(DEMOD-
ULATOR)
6
ADC
7
DISPLAY
PROCESSOR
8
DRIVER
11
12
CRT
3
OR
LIQUID
CRYSTAL
DISPLAY
13
PROGRAMMABLE
LOGIC
10
OTHER
VIDEO
SOURCE
4
OR
PLASMA
DISPLAY
14

FIG. 1

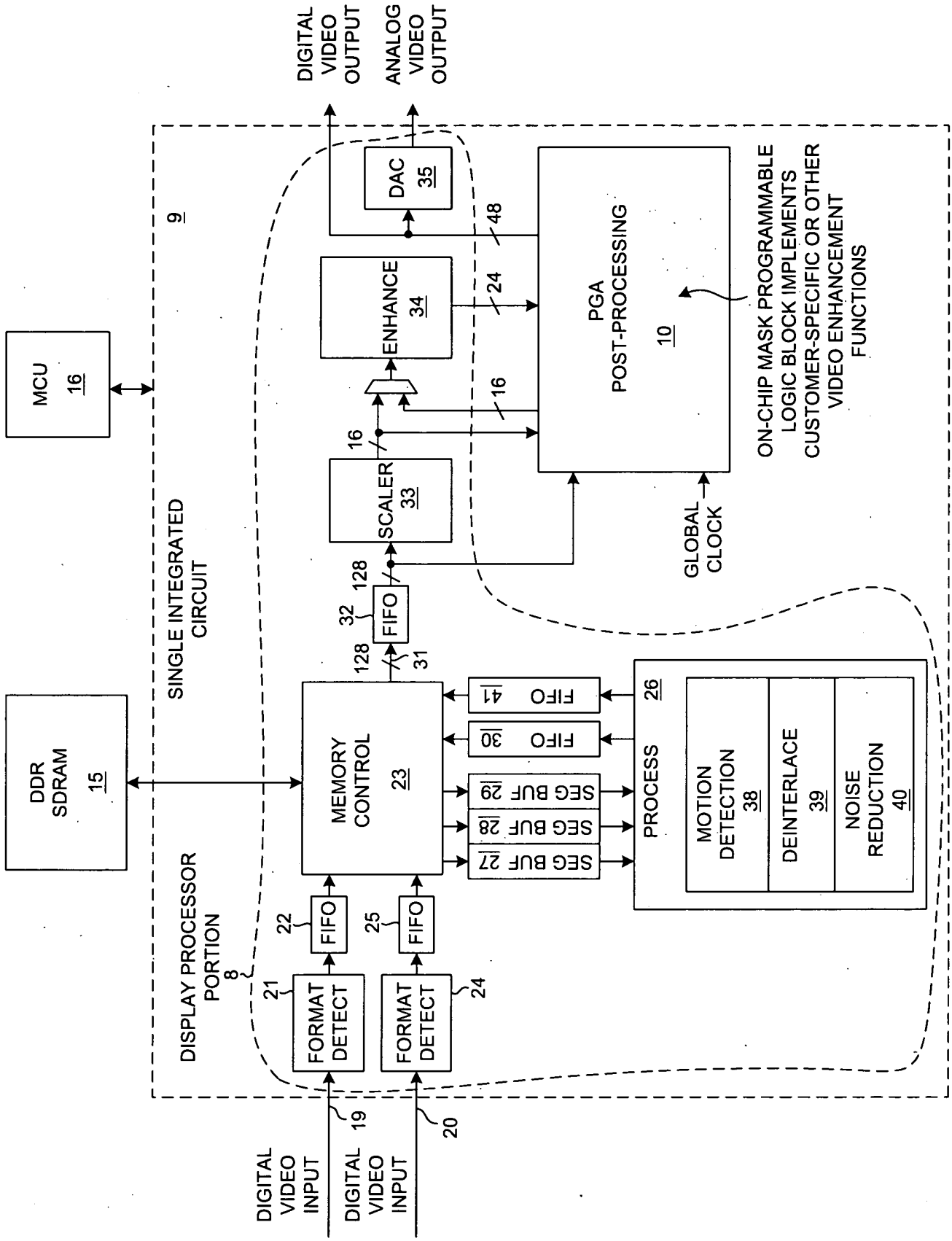

DIGITAL VIDEO OUTPUT
ANALOG VIDEO OUTPUT
DAC 35
48
ENHANCE 34
24
PGA POST-PROCESSING 10
ON-CHIP MASK PROGRAMMABLE LOGIC BLOCK IMPLEMENTS CUSTOMER-SPECIFIC OR OTHER VIDEO ENHANCEMENT FUNCTIONS
MCU 16
16
16
SCALER 33
GLOBAL CLOCK
9
SINGLE INTEGRATED CIRCUIT
32
128
FIFO
128
31
DDR SDRAM 15
MEMORY CONTROL 23
FIFO 41
FIFO 30
SEG BUF 29
SEG BUF 28
SEG BUF 27
26
PROCESS
MOTION DETECTION 38
DEINTERLACE 39
NOISE REDUCTION 40
22
FIFO
25
FIFO
DISPLAY PROCESSOR PORTION 8
21
FORMAT DETECT
24
FORMAT DETECT
DIGITAL VIDEO INPUT
19
DIGITAL VIDEO INPUT
20

FIG. 2

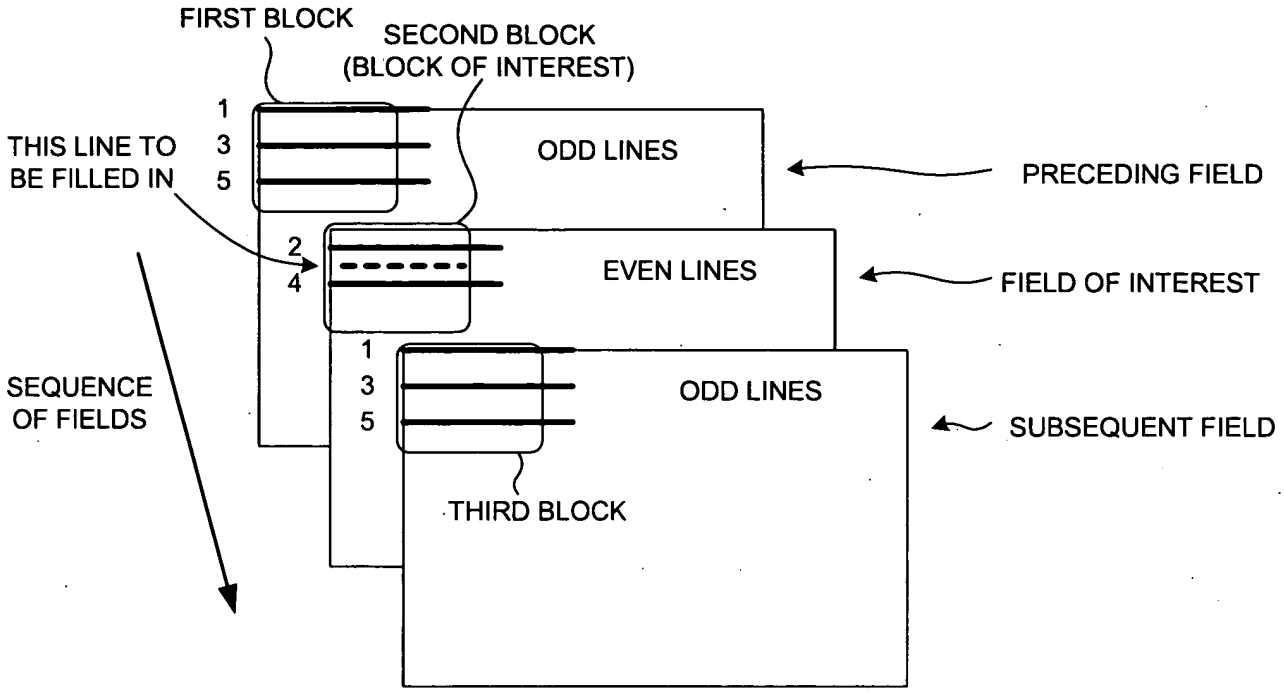

FIRST BLOCK
SECOND BLOCK
(BLOCK OF INTEREST)
1
3
5
THIS LINE TO
BE FILLED IN
ODD LINES
PRECEDING FIELD
2
4
EVEN LINES
FIELD OF INTEREST
1
3
5
ODD LINES
SUBSEQUENT FIELD
SEQUENCE
OF FIELDS
THIRD BLOCK

FIG. 3

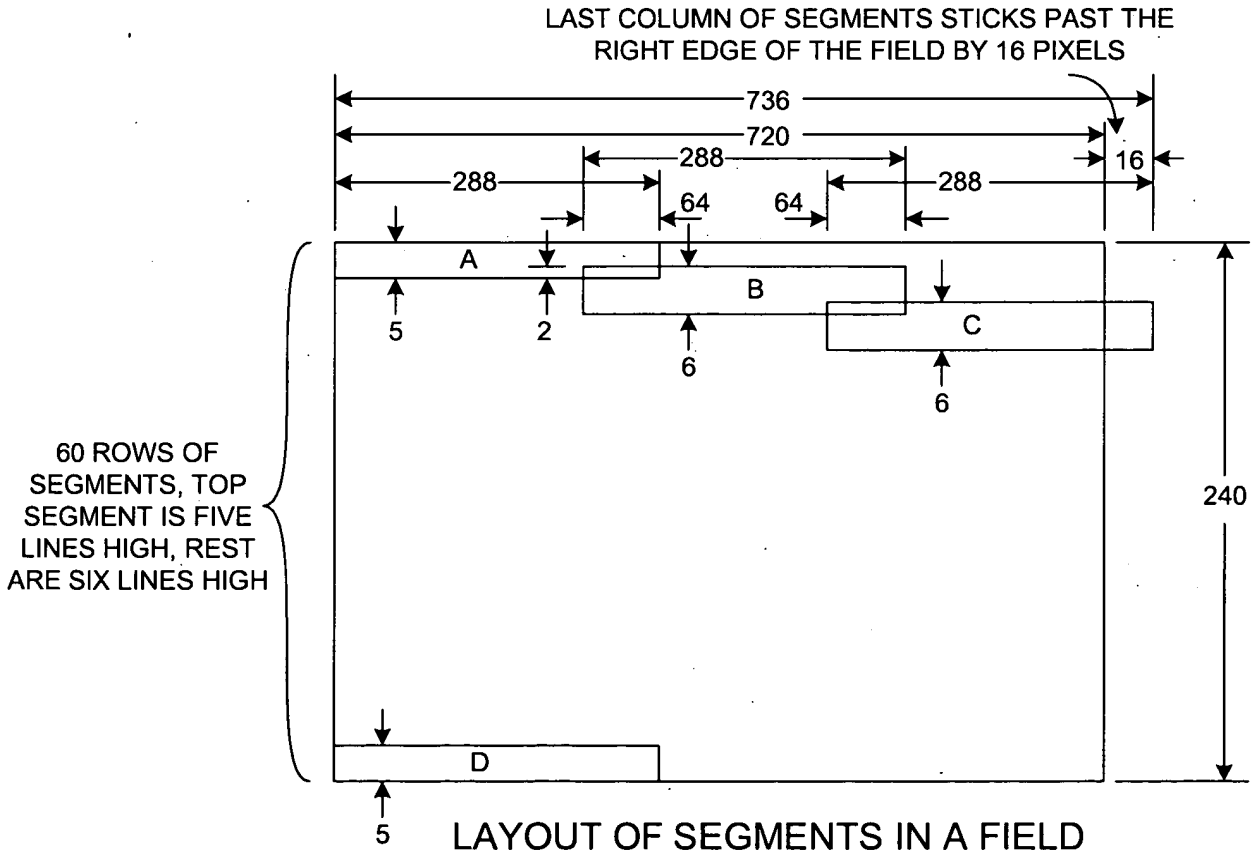
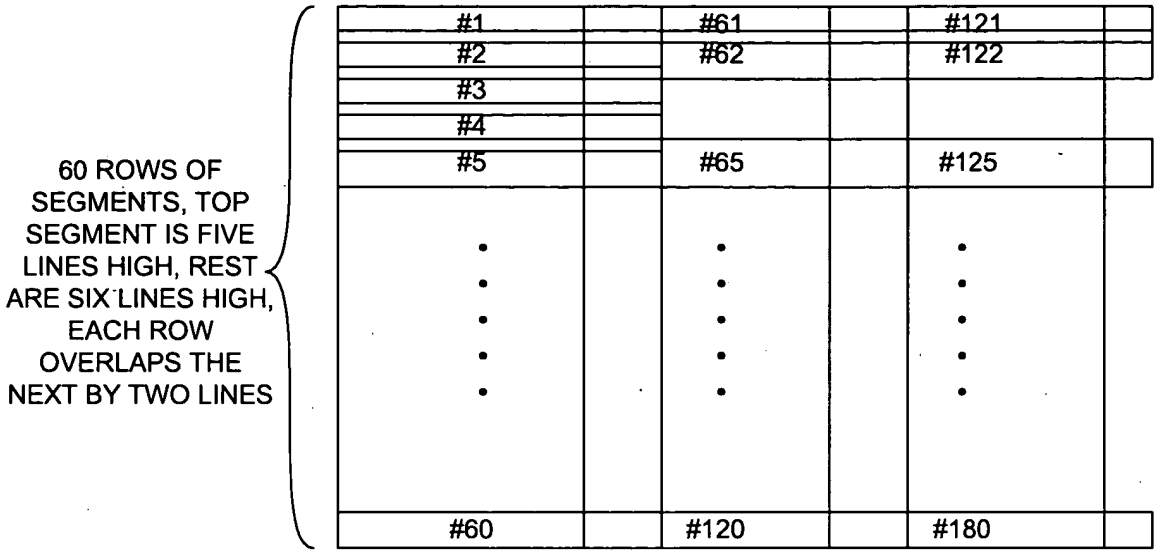
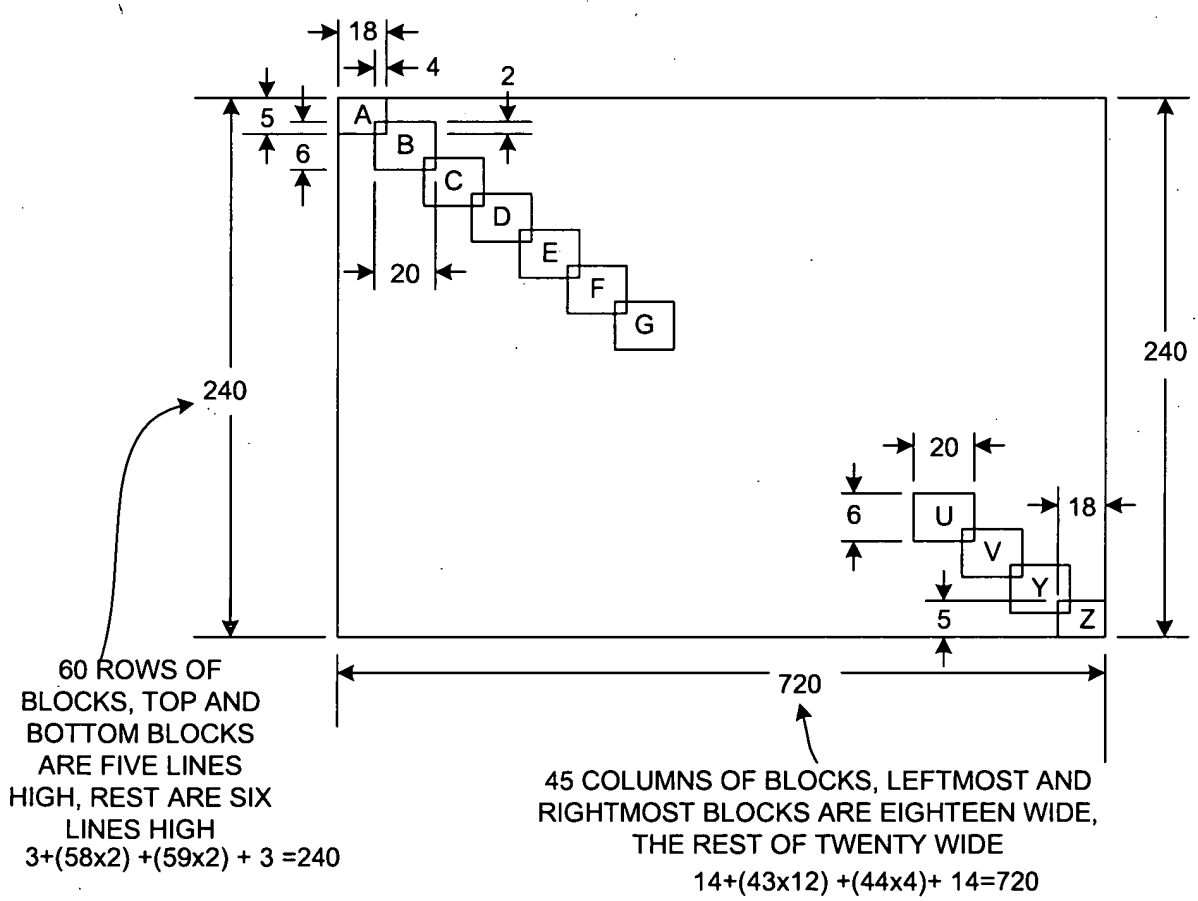

LAST COLUMN OF SEGMENTS STICKS PAST THE
RIGHT EDGE OF THE FIELD BY 16 PIXELS
736
720
288
16
288
64
64
288
A
B
C
D
5
2
6
6
5
60 ROWS OF
SEGMENTS, TOP
SEGMENT IS FIVE
LINES HIGH, REST
ARE SIX LINES HIGH
240
LAYOUT OF SEGMENTS IN A FIELD

FIG. 4



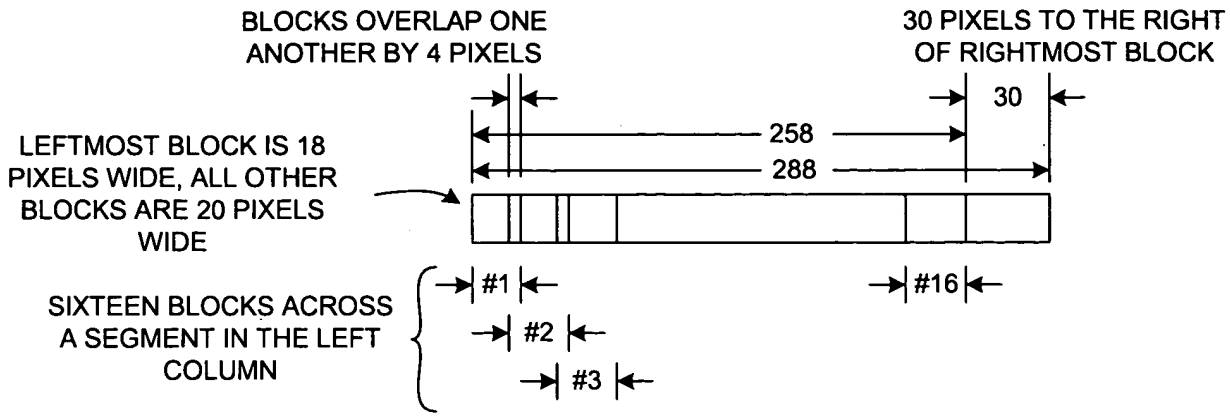
SEGMENT LOADING SEQUENCE

FIG. 5



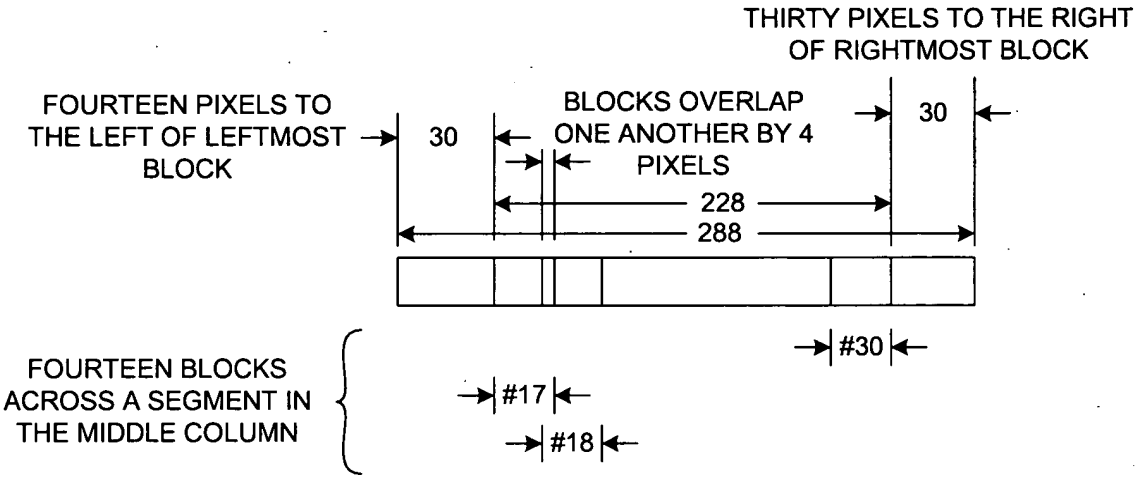
LAYOUT OF BLOCKS IN A FIELD

FIG. 6



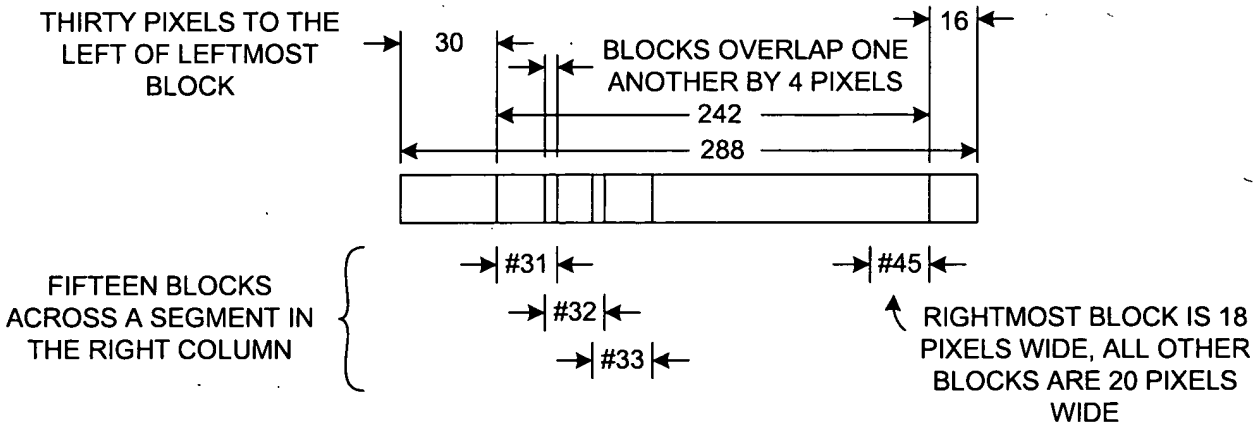
BLOCKS IN A SEGMENT IN THE LEFT COLUMN

FIG. 7A



BLOCKS IN A SEGMENT IN THE MIDDLE COLUMN

FIG. 7B



BLOCKS IN A SEGMENT IN THE RIGHT COLUMN

FIG. 7C

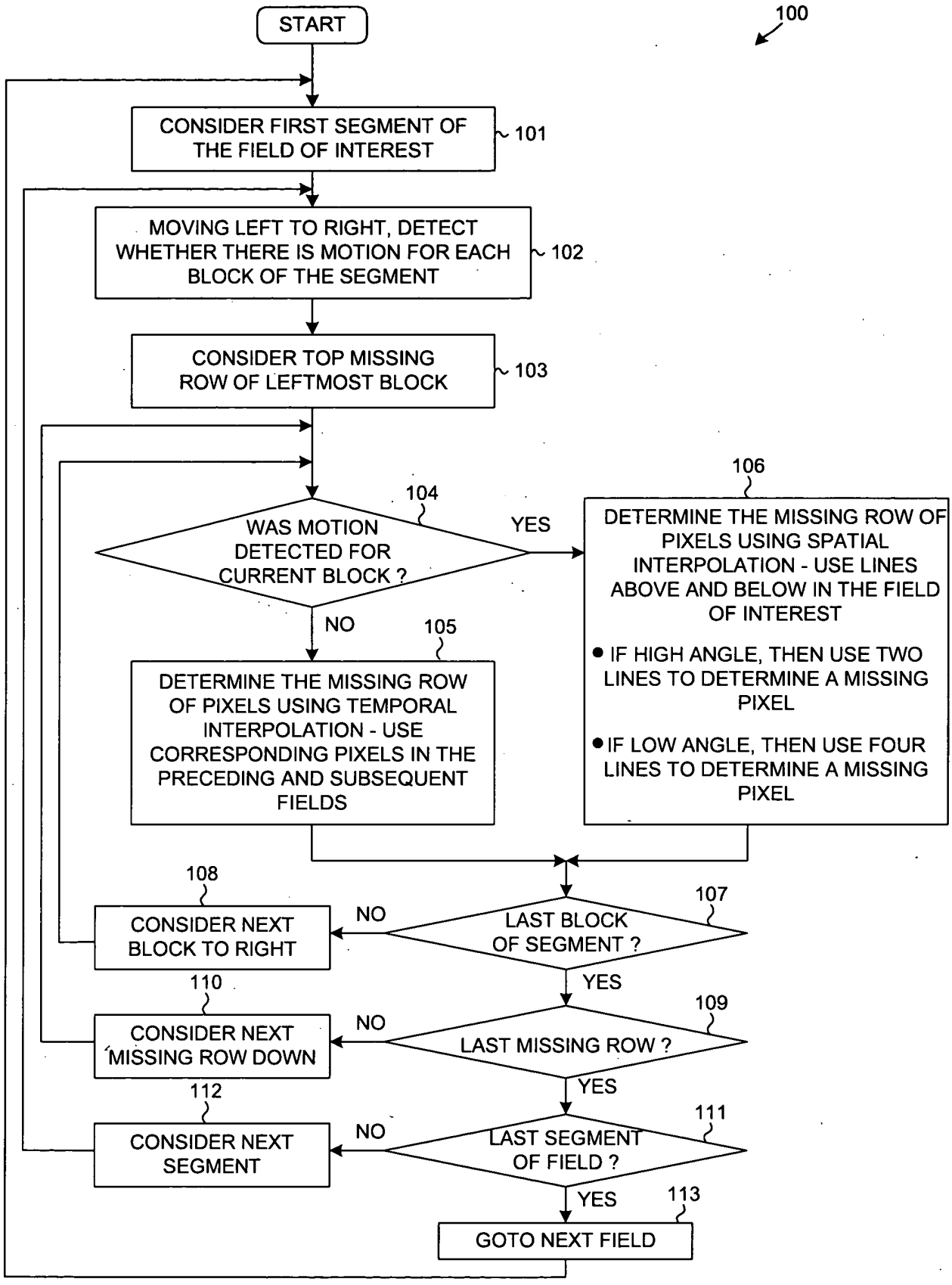

100
START
CONSIDER FIRST SEGMENT OF THE FIELD OF INTEREST
101
MOVING LEFT TO RIGHT, DETECT WHETHER THERE IS MOTION FOR EACH BLOCK OF THE SEGMENT
102
CONSIDER TOP MISSING ROW OF LEFTMOST BLOCK
103
104
WAS MOTION DETECTED FOR CURRENT BLOCK ?
YES
NO
105
DETERMINE THE MISSING ROW OF PIXELS USING TEMPORAL INTERPOLATION - USE CORRESPONDING PIXELS IN THE PRECEDING AND SUBSEQUENT FIELDS
106
DETERMINE THE MISSING ROW OF PIXELS USING SPATIAL INTERPOLATION - USE LINES ABOVE AND BELOW IN THE FIELD OF INTEREST
• IF HIGH ANGLE, THEN USE TWO LINES TO DETERMINE A MISSING PIXEL
• IF LOW ANGLE, THEN USE FOUR LINES TO DETERMINE A MISSING PIXEL
107
LAST BLOCK OF SEGMENT ?
NO
YES
108
CONSIDER NEXT BLOCK TO RIGHT
109
LAST MISSING ROW ?
NO
YES
110
CONSIDER NEXT MISSING ROW DOWN
111
LAST SEGMENT OF FIELD ?
NO
YES
112
CONSIDER NEXT SEGMENT
113
GOTO NEXT FIELD

FIG. 8

IN A BLOCK:

$P_{i,j}$ IS A LUMINANCE VALUE AT THE ith ROW AND jth COLUMN IN A BLOCK OF FIELD (t-1)

$Q_{i,j}$ IS A LUMINANCE VALUE AT THE ith ROW AND jth COLUMN IN THE BLOCK AT THE SAME POSITION OF FIELD (t+1)

$i \in [0, \text{BLOCK_WIDTH}]$

$j \in [0, \text{BLOCK_HEIGHT}]$

$$\text{SUM} = \sum_{j=0}^{\text{BLOCK_HEIGHT}-1} \sum_{i=0}^{\text{BLOCK_WIDTH}-1} \frac{(P_{i,j} + Q_{i,j})}{2}$$

$$\text{DIFF} = \sum_{j=0}^{\text{BLOCK_HEIGHT}} \sum_{i=0}^{\text{BLOCK_WIDTH}} \left| P_{i,j} - Q_{i,j} \right|$$

```
IF ( DIFF > SUM * THRESHOLD_RATIO )
   THEN { THERE IS MOTION ;
          MOTION_SIGNAL = 1 ;
          USE SPATIAL INTERPOLATION RESULTS ; }
   ELSE { THERE IS NO MOTION ;
          MOTION_SIGNAL = 0 ;
          INTERPOLATE USING THE AVERAGE OF FIELD(t-1) AND FIELD(t+1) ; }
FINAL_RESULT = MOTION_SIGNAL | CORRESPONDENT MOTION HISTORY BIT ;
CORRESPONDENT MOTION HISTORY BIT = MOTION_SIGNAL ;
```

BLOCK-BASED MOTION DETECTION

FIG. 9

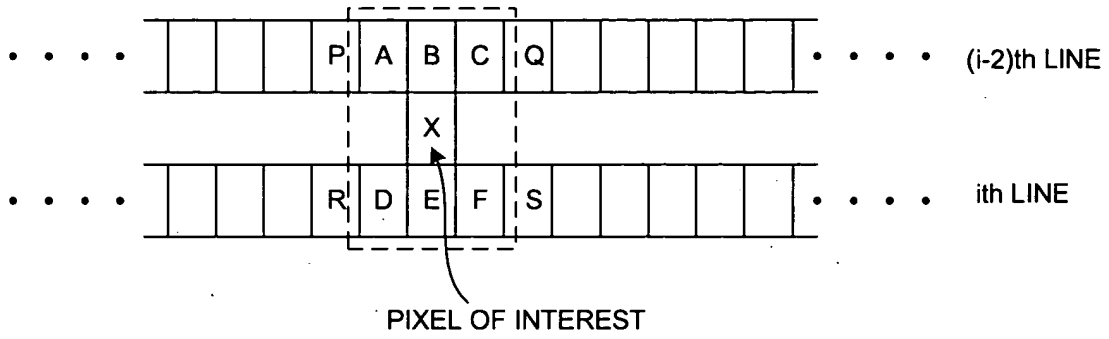


FIG. 10

$$\text{VERT_GRAD} = \frac{A - D + 2 * (B - E) + C - F}{4}$$

$$\text{HORI_GRAD} = \frac{A - C + D - F}{2}$$

IF $\left(| \text{VERT_GRAD} | + | \text{HORI_GRAD} | < \text{THRESHOLD} \right)$ THEN

$$X_L = \frac{B + E}{2} \quad ; \qquad X_C = \frac{B + E}{2}$$

ELSE IF $\left\{ \left\{ \frac{| \text{VERT_GRAD} |}{| \text{HORI_GRAD} |} > \text{TAN}\left(68^{o}\right) \right\} \text{ OR } \left\{ \frac{| \text{VERT_GRAD} |}{| \text{HORI_GRAD} |} < \text{TAN}\left(23^{o}\right) \right\} \right\}$ THEN

$$X_L = \frac{B + E}{2} \quad , \qquad X_C = \frac{B + E}{2} \quad ;$$

ELSE IF $\left\{ \frac{\text{VERT_GRAD}}{\text{HORI_GRAD}} < 0 \right\}$ THEN (LEFT TILT) :

$$X_L = \frac{A + F}{2} \quad , \qquad X_C = \frac{P + S}{2} \quad ;$$

ELSE (RIGHT TILT) :

$$X_L = \frac{D + C}{2} \quad , \qquad X_C = \frac{Q + R}{2} \quad ;$$

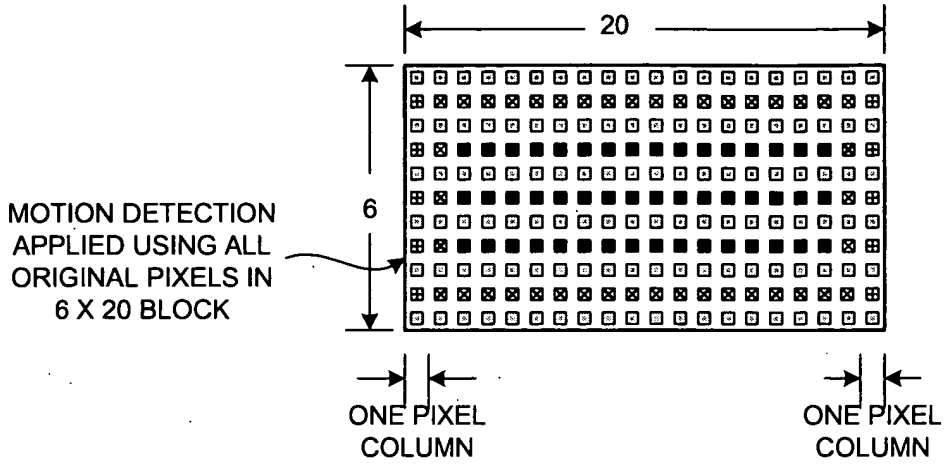
WHERE

X_L IS LUMINANCE

X_C IS CHROMINANCE

HIGH ANGLE SPATIAL INTERPOLATION

FIG. 11



SYMBOL	DESCRIPTION
⊠	PIXEL TO BE GENERATED - HIGH ANGLE SPATIAL INTERPOLATION CAN BE APPLIED, BUT LOW ANGLE SPATIAL INTERPOLATION CANNOT.
⊞	PIXEL TO BE GENERATED - NEITHER HIGH ANGLE NOR LOW ANGLE SPATIAL INTERPOLATION CAN BE APPLIED - USE TEMPORAL INTERPOLATION.
■	PIXEL TO BE GENERATED - LOW OR HIGH ANGLE SPATIAL INTERPOLATION CAN BE APPLIED.
⊡	ORIGINAL PIXEL.

FIG. 12